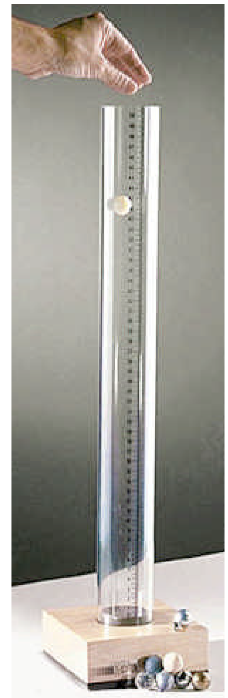
The Coefficient of Restitution



What is this about?
The rules of baseball state a legal baseball traveling at 60mph at a wall of northern white ash must rebound with a speed of 54.6 ± 3.2% of the initial speed. This number, 0.546, is called the "coefficient of restitution," or COR. You will measure the COR of a several balls including a baseball.

What do I need?
The experiment requires a Sargent-Welch Coefficient of Restitution Demonstrator WL0556, a baseball, a meter stick, and a calculator.

What will I be doing?
When a ball is dropped from a given height, the speed that it hits the ground is proportional to the square root of the height. Similarly, if a ball leaves the ground and rises to a given height, the speed it left the ground is proportional to the square root of the height. Since the COR is the ratio of the outgoing speed to the incoming speed, you can measure it by finding the square root of the ratio of the heights. So, you will drop a ball from a height of one meter, measure the height of the bounce, and calculate the COR.

What do I think will happen?
Take a minute and write down a description of what you think will happen and why you think it. Which ball will have the greatest COR? Which balls will have a COR greater than the baseball?

What really happened?
1. Drop each ball from the top of the COR Demonstrator and measure the height of the bounce. You may want to repeat this several times and take an average.
2. Drop a baseball from a height of one meter and measure the height of the bounce. Again, you may want to repeat this several times and take an average.
3. Calculate the COR for each ball by taking the square root of the final height divided by the initial height.

Write a description of your results. Which ball has a greatest COR? Where does the baseball rank?

What did I learn?
The COR is the outgoing speed after a collision divided by the incoming speed. You can calculate the COR from the square root the ratio of the height of the drop divided by the height of the bounce. Did the baseball have a COR near 0.546? Probably not…

What else should I think about?
For baseballs, like most objects, the COR depends upon many factors. At the right is a picture of a baseball hitting a wall at 120mph. The ball is very deformed during impact. It returns to the proper shape as it leaves the wall, however, the COR of a ball-wall collision varies depending on just how deformed the ball gets. Since the baseball dropped from a height of one meter is barely deformed, its COR will likely be different than a baseball hitting a wall at 60mph. This explains why the rules of baseball specify the speed of the collision.